

REMARKS

Status Of Application

Claims 1-21 were pending in the application; the status of the claims is as follows:

Claims 1-3, 7-9 and 19-21 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. Patent No. 5,389,943 to Brommer et al. (hereinafter "Brommer") in view of U.S. Patent No. 6,052,213 to Burt et al. (hereinafter "Burt").

Claims 4-6 and 10-18 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Burt, in view of Brommer.

Drawings

The indication, in the Office Action that the drawings filed March 27, 2001 are accepted by the Examiner, is noted with appreciation.

Claim Amendments

Claims 3, 9, and 21 have been amended to provide proper dependency. These changes are not necessitated by the prior art, are unrelated to the patentability of the invention over the prior art, and do not introduce any new matter. Claims 1, 7, and 19 were amended to more precisely describe the invention. These amendments do not introduce any new matter. Claims 4, 10, 13, and 16 have been amended to include a limitation of a respective dependent claim and to more precisely describe the invention. No new matter was introduced.

35 U.S.C. § 103(a) Rejections

The rejection of claims 1-3, 7-9 and 19-21 under 35 U.S.C. § 103(a), as allegedly being unpatentable over Brommer, in view of Burt, is respectfully traversed based on the following.

Claims 2, 8, and 20 have been cancelled herein by this amendment. Thus, the rejection of these claims is moot.

Claim 1 recites an optical device comprising:

a first medium having a thickness, the first medium defining a plurality of periodically spaced hollow portions having a depth less than the thickness of the first medium; and

a second medium being dispersed within the hollow portions formed in the first medium,

wherein a first layer of the device forms a photonic crystal formed partially of the first medium having a depth identical to the depth of the hollow portions, and

wherein a second layer of the device is formed entirely of the first medium.

That is, claim 1 requires the device is formed of a first medium having two parts: a first layer formed partially of the first medium and defining a plurality of hollow portions each having a depth less than a thickness of the first medium and each having a second medium disposed therein, where a depth of the first layer is identical to the depth of the hollow portions, and a second layer of the device formed entirely of the first medium. Thus, the first layer forms a photonic crystal of the depth of the hollow portions.

In contrast, Brommer discloses two filters. One is a band stop filter and another is a tunable filter. Both filters have lattice structure. The lattice structure comprises a plurality of parallel elongated elements formed of a non-conductive, high-dielectric material disposed in a two-dimensional periodic arrangement within the background material made of a non-conductive, high-dielectric material. *See* Col. 1, line 52 to Col. 2, line 14. As stated in Brommer, the elements extend through the background material. *See* Col. 2, lines 9-14. Further, as acknowledged on page 2 of the Office Action, Brommer **fails** "to teach the hollow portions having a depth less than the thickness of the first medium". Thus, claim 1 is not obvious with respect to Brommer.

Burt discloses an optical diffracting grating and method of manufacture. The optical diffracting grating is formed having a region of photonic crystalline material. As

illustrated in Figs. 5, 6 and 7a of Burt, the diffracting grating is formed of multiple alternating layers (InP, Q, InP etc.), one of which, Q, is a waveguide layer. Holes are disposed through the multiple layers, and later possibly filled with another material.

Burt **does not** disclose or suggest a device formed of a first medium, with hollow portions having a depth **less than** the thickness of the first medium, thereby defining a first layer – waveguide layer from a second layer – base layer. To the contrary, according to Fig. 5 of Burt, the hollow portion extends through a planar substrate comprising a plurality of independent layers. The hollow portion extends **throughout the thickness** of the first medium (top planar layer – unknown medium), **throughout the thickness** of the second medium (second planar layer – InP – cladding layer), **throughout the thickness** of the third medium (third planar layer – Q – waveguide layer), and at least partially into the fourth medium (fourth planar layer – InP – skim layer). Additionally, the fourth layer is disposed on a fifth medium (fifth layer – InP – base layer). According to Fig. 6, the holes are filled with a III-V semiconductor material such as InP itself, or a ternary such as GaInAs.

With respect to Burt, if any one of the InP layers is held to be the first medium, then the depth of the hole is **not identical to the depth of the first layer**, as the hole either extends **beyond the layer or only partially therethrough**. If the “Q” waveguide layer is held to be the first medium, then the hole extends completely through the first medium and is thus not “less than a depth of the first medium”. Thus, the disclosure of Burt does not apply to claim 1. Therefore, claim 1 is not obvious with respect to Burt.

Additionally, the interpretation, as alleged in the Office Action that the planar substrate of Fig. 5 of Burt is equivalent in structure to the high-dielectric background material in Fig. 1 of Brommer, is incorrect. The background material of Brommer is a filter itself. In contrast, buffer layer in Fig. 5 of Burt does not function as a filter in the usage of the filter of Burt. In Burt, the portion functioning as a filter is “Q” illustrated in Fig. 6. Burt does not disclose or suggest that the buffer layer having the hollows filled with a III-V semiconductor is functioning as a filter.

Since both Brommer and Burt fail to teach the same limitation, i.e., that the hollow portions have a depth less than the thickness of the first medium and the first layer has a depth of the depth of the hollow portions, claim 1 is not obvious with respect to either reference, either singly or in combination. As claim 3 depends from claim 1, claim 3 is also not obvious with respect to the cited references, either singly or in combination.

Claim 7 recites: an optical device comprising:

- a first medium having a thickness, the first medium at least partially forming a first layer and a second layer of the optical device, the first layer having a plurality of periodically spaced protruding portions surrounded by hollow portions having a depth less than the thickness of the first medium, the first layer having a depth identical to the depth of the hollow portions; and

- a second medium being dispersed within the hollow portions surrounding the plurality of periodically spaced protruding portions of the first layer,

- wherein the first layer is a photonic crystal, and the second layer is formed entirely of the first medium, and

- wherein the first layer and the second layer are integrated.

For the reasons presented above with respect to claim 1, claim 7 is also not obvious with respect to Brommer or Burt, either singly or in combination. Further, neither Brommer nor Burt disclose an integrated first layer (photonic crystal layer) and second layer. As claim 9 depends from non-obvious claim 7, it too is not obvious with respect to the cited references, either singly or in combination.

Claim 19 recites: an optical device comprising:

- a first medium having a thickness, the first medium at least partially forming an integrated first layer and second layer of the optical device, the first layer defining a plurality of periodically spaced hollow portions, the hollow portions having a depth less than the thickness of the first medium, the first layer having a depth identical to the depth of the hollow portions; and

- a second medium being dispersed within the hollow portions, wherein the first layer of the optical device forms a photonic crystal, and

wherein the second layer of the device is formed at least partially of the first medium.

For the reasons presented above with respect to claim 1, claim 19 is also not obvious with respect to Brommer or Burt, either singly or in combination. Further, neither Brommer nor Burt disclose or suggest a device having an integrated first layer (photonic crystal layer) and second layer. As claim 21 depends from non-obvious claim 19, it too is not obvious with respect to the cited references, either singly or in combination.

Accordingly, it is respectfully requested that the rejection of claims 1, 3, 7, 9, 19, and 21 under 35 U.S.C. § 103(a) as allegedly being unpatentable over Brommer, in view of Burt, be reconsidered and withdrawn.

The rejection of claims 4-6 and 10-18 under 35 U.S.C. § 103(a), as allegedly being unpatentable over Burt, in view of Brommer, is respectfully traversed based on the following.

Claims 5, 6, 11, 12, 14, 15, 17, and 18 have been cancelled. Thus, the rejection with respect to these claims is moot.

Claim 4 recites: a method of manufacturing an optical device having a first layer functioning as an optical waveguide layer and a second layer functioning as a base layer, the method comprising the steps of:

- providing a resist layer on a surface of a first medium;
- removing portions of the resist layer to form vacancies;
- removing portions of the first medium corresponding to the vacancies to create cavities in the first medium, the depth of the cavities being less than a thickness of the first medium, and thereby defining the first layer and the second layer;
- removing the resist layer completely;
- filling the cavities in the first medium with a second medium, thereby forming the optical waveguide layer; and
- removing any excess film of the second medium from the surface of the first medium,
- wherein the index of refraction of the second medium is greater than the index of refraction of the first medium.

Thus, by the method described above, an optical device having an integrated optical waveguide layer and a base layer is formed in a few simple steps. The method of claim 4 reduces the number of steps of manufacturing, and reduces the cost and time of manufacturing by reducing the number of man-hours (for coating and stacking and so on as required by the methods of the cited references).

In contrast, the device of Burt is formed as disclosed in Col. 4, lines 66 – Col. 5, line 65. The process of forming is broken down into two stages, a forming stage, and an etching stage. In the forming stage, a buffer layer is deposited. A waveguide layer is deposited thereon. A cladding layer is deposited thereon. The sample is cleaned, and then a layer of silicon nitride is deposited. A layer of photoresist is spun onto the sample, and then exposed by electron beam lithography. The resist is then developed, which dissolves the exposed areas. The unexposed areas remain as a mask. The mask pattern is then transferred from the resist layer onto the silicon nitride layer. The sample is then cleaned in two stages. At that time, the main RIE process is carried out. The polymer resulting from the RIE process is removed and the sample is thinned. The holes can then be filled with a second dielectric material having a different refractive index of the substrate. As is evident, this method is completely different that the method claimed in claim 4 of the present application. One primary difference in the two methods is that in Burt, the waveguide layer is deposited completely formed onto the buffer layer and is then covered by a cladding layer prior to etching of holes through the cladding, waveguide layer, and into the buffer layer and then the subsequent refilling of the holes. In the method of the present invention, the waveguide layer, which is formed by the process of forming hollow portions only partially through a first medium and then filling the hollow portions with a second material, is not formed until after the hollow portions are filled with the second medium. The second medium has an index of refraction greater than that of the first medium. The base layer, which is a layer of the first medium not containing the hollow portions, is thus distinguished from the waveguide layer at the time the hollow portions are formed.

Further, as acknowledged on page 5 of the Office Action, Burt fails to teach both "the first medium comprising one material", and "removing the resist layer and any excess film of the second medium from the surface of the first medium and the first medium comprising one material". Further, Burt fails to disclose or suggest "removing portions of the first medium corresponding to the vacancies to create cavities in the first medium, ... thereby defining the first layer and the second layer". Thus, the method of claim 4 is not obvious with respect to Burt.

Brommer fails to disclose or suggest the depth of the cavities being less than a thickness of the first medium. Further, Brommer fails to disclose or suggest "removing portions of the first medium corresponding to the vacancies to create cavities in the first medium, ... thereby defining the first layer and the second layer". Further, Brommer does not disclose that the cylindrical bores can be filled with higher-dielectric materials than the non-conductive high-dielectric material of the background material. Thus, the method of claim 4 is not obvious with respect to Brommer.

As neither Burt nor Brommer, either singly or in combination, discloses a method which forms an optical device in a manner, as claimed in claim 4, whereby the first and second layers would be integrally formed and defined at the time of the creation of the cavities, the method of claim 4 is not obvious with respect to the cited references, either singly or in combination.

Likewise, for the reasons presented above with respect to claim 4, claims 10, 13, and 16 are also not obvious with respect to Burt or Brommer, either singly or in combination.

Accordingly, it is respectfully requested that the rejection of claims 4 and 10, 13, and 16 under 35 U.S.C. § 103(a) as allegedly being unpatentable over Burt, in view of Brommer, be reconsidered and withdrawn.

CONCLUSION

Wherefore, in view of the foregoing amendments and remarks, this application is considered to be in condition for allowance, and an early reconsideration and a Notice of Allowance are earnestly solicited.

This Amendment does not increase the number of independent claims, does not increase the total number of claims, and does not present any multiple dependency claims. Accordingly, no fee based on the number or type of claims is currently due. However, if a fee, other than the issue fee, is due, please charge this fee to Sidley Austin Brown & Wood LLP's Deposit Account No. 18-1260.

Any fee required by this document other than the issue fee, and not submitted herewith should be charged to Sidley Austin Brown & Wood LLP's Deposit Account No. 18-1260. Any refund should be credited to the same account.

If an extension of time is required to enable this document to be timely filed and there is no separate Petition for Extension of Time filed herewith, this document is to be construed as also constituting a Petition for Extension of Time Under 37 C.F.R. § 1.136(a) for a period of time sufficient to enable this document to be timely filed.

Any other fee required for such Petition for Extension of Time and any other fee required by this document pursuant to 37 C.F.R. §§ 1.16 and 1.17, other than the issue fee,

Serial No. 09/818,304

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Respectfully submitted,

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March 12, 2003

DAI 256345v4